EFFECT OF CHALLENGE-BASED AND ACTIVITY-BASED LEARNING APPROACHES ON TECHNICAL COLLEGE STUDENT'S ACHIEVEMENTS AND RETENTION IN WOODWORK TECHNOLOGY

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Abstract: *This study was designed to determine the effects of challenge-based and activity-based learning approaches on technical college students' achievement and retention in woodwork technology. A pre-test, post-test, non-equivalent control group, quasi-experimental research design was adopted. The study constituted a total number of 122 subjects, 63 for the Challenge based learning, while 59 for the activity-based learning. three research questions and three null hypotheses, tested at 0.05 level of significance, guided the study. The instruments used for data collection were Woodwork Cognitive Achievement Test (WCAT). Other instruments used were the challenge-based and activity-based learning lesson plans. The items of the WCAT were based on table of specifications built in order to ensure the content validity of the test. The instruments were also subjected to face validation by five experts in woodwork technology from Department of Industrial and Technology Education, Federal University of Technology Minna and woodwork technology teachers at Government Technical Colleges in Niger State. The WCAT was trial-tested to determine its psychometric indices and reliability coefficient. The trial test for determining the coefficient of stability of the WCAT was carried out using test re-test reliability method. Pearson product moment correlation coefficient of WCAT was found to be .78. In addition, Kuder Ricahrdson 21 (K-R 21) was used to test the internal consistency of the WCAT. The reliability coefficient obtained was .76. Mean was used to answer the research questions; while ANCOVA was employed to test the hypotheses. The study revealed that students taught woodwork using the challenge-base learning instructional approach had a higher mean score than students taught using the activity-base learning teaching method in cognitive achievement test. In each mean score of males taught woodwork using challenge-base learning instructional approach was higher than the mean score of females taught using the same challenge-base learning instructional approach in the cognitive achievement test. Consequently, the research recommended that the National Board for Technical Education (NBTE) should consider a review of Woodwork work curriculum for Technical Colleges with a view to incorporating the challenge-based learning instructional approach into the teaching of woodwork*

Keywords: *Challenge-based learning, Activity-based, Learning, Technical College, Students Achievement, Woodwork and Technology*

1. INTRODUCTION

Woodwork technology is one of the vocational subjects studied in technical colleges in Nigeria. The goal of Woodwork technology in technical colleges according to National Board for Technical Education (NBTE, 2007) is to produce skilled craftsmen for self or paid employment in the world of work. The skill areas for employment in woodwork include: machine Operations, Furniture Making, Upholstery Design and Construction, Carpentry and Joinery. All these areas of woodwork technology are changing rapidly and as such demand that practitioners should have flexible skills and can easily adapt to changes.

The rapid changes in technology have necessitated the need to equip technical college students with workplace basic and thinking skills which will make them flexible and adaptable to the present and envisaged future changes. Technology, the world over is dynamic and work organizations are getting increasingly flexible, process-based and multi-tasking. This apparently is to suit demands of the prevalent knowledge society and ample use of innovations and inventions in work places and changes in the organization of work (Ogwo and Oranu, 2006). In this context, there is need for educational institutions to adjust their curriculum to accommodate changes in work places so as to produce students with work place basic skills required to thrive in the 21st century knowledge-based economy and society (Boyle, Duffy & Dunleavy, 2011). The changes in the curriculum of Woodwork technology are also necessary to accommodate changes in the sector.

This continuous poor academic achievement most often reduces students‘interest and can lead to poor knowledge retention in woodwork technology as well as other adverse effects on the entire programme objectives of woodwork technology. Students sometimes hate a subject which records high rate of failure in examination and retention of knowledge is seriously dependent on achievement and interest. Considering this poor achievement of students in woodwork technology subject, one is bound to be worried. Teaching and learning in Woodwork technology however, might be enhanced by the adoption of teaching/learning approaches rooted in problem-based learning approach.

Problem based learning (PBL) is one of the constructivist learning strategy which posits significant contextualized real world situation, providing resources, guidance and instruction to learning as the students develop content knowledge and problem solving skills. PBL is a student-centered, self-directed integrated and contextual mode of learning. Problem based learning requires learners to actively explore information resources other than the teacher, including primary documents, reference materials and community members, and to draw on knowledge from diverse subject areas. Hence, Ogbuanya (2008) recommended that students should take responsibility for their own learning and the teachers should be looked at more as mentors and less as presenters of information. Therefore, instructional methods rooted in PBL could be a sure way of teaching both theory and practical in woodwork. It helps the students to learn how to learn and reduces the teacher‘s instruction, since the learners are actively involved.

Prominent among teaching and learning approaches that are rooted on problem-based learning are challenge-based and activity-based learning approaches. Challenge-based learning (CBL) is an engaging multidisciplinary approach to teaching and learning that encourages

students to leverage the technology they use in their daily lives to solve real-world problems (Johnson and Adams, 2011). The authors maintained that challenge based learning begins with a big idea and cascades to the following: the essential question; the challenge; guiding questions, activities, and resources; determining and articulating the solution; taking action by implementing the solution. Further, Abubakar (2013) stressed that Challenge – Based learning builds on the practice of problem-based learning, in which students work on real-world problems in collaborative teams, but with key distinctions that add a great deal of relevancy for students. At the center of Challenge – Based learning is a call to action that inherently requires students to make something happen. They are compelled to research on their topic, brainstorm strategies and solutions that are both credible and realistic in light of time and resources, and then develop and execute one of those solutions that addresses the challenge in ways both they themselves and others can see and measure.

Achievement in Woodwork technology connotes performance in the school subject as symbolized by a score or mark on Woodwork achievement test. Students'achievement in vocational and technical education according to Beesley (2012) is defined as the learning outcomes of student which include the knowledge, skills and ideas acquired and retained through his course of studies within and outside the classroom situation. Kolo (2013) noted that students' cognitive or psychomotor achievement is quantified by a measure of the student's academic standing in relation to those of other students of his age.

Gender refers to the characteristics, whether biological or socially influenced, by which people define male and female (Myers, 2002). Gender may also be explained as the socially constructed roles, behaviors, activities and attributes that a given society considers appropriate for men and women. Disparities according to Beesley, (2012) usually exist in the levels of performance between males and females. This study will therefore, ascertain if students' achievement, retention of learning and interest in studying Woodwork technology will reflect students' gender after being exposed to challenge based learning teaching approach and Activity – Based learning teaching approach. Students'achievement and retention of learning is most often dependent upon several factors among which are learning environment and instructional method. Instructional method rooted in challenge based learning teaching approach or Activity – Based learning teaching approach seem to provide a learning environment that gives students deeper engagement in the learning process which may influence students' retention of learning in Woodwork technology.

The abilities of a woodwork craftsman in the area of construction and repair of woodwork products may therefore be enhanced through teaching and learning approaches such as Challenge – Based or Activity – Based learning approach. Hence, this study will attempt to find out which of these teaching/learning approaches will be more effective in improving students 'achievement in wood work technology.

1.2 Statement of the Problem

The skills needed in design, processing and production of woodwork products are becoming increasingly complex. This is as a result of the rapid rate of technological development in the world of work. The Woodwork workplace has improved technologically especially in the 21st

century where employers in the Woodwork world of work are seeking for employees with workplace skills such as higher order thinking skills, creativity and problem solving skills.

The conventional teaching methods (such as lecture and demonstration methods) adopted by most Woodwork technology teachers in technical colleges seem inadequate for equipping the Woodwork craftsmen with the workplace skills such as flexibility, adaptability, creativity, high order thinking and problem solving. These teaching/learning methods are teacher-centered, hence, do not give students enough opportunities to think for themselves and actively participate in the learning process. The short coming of these methods of teaching could partly be responsible for the poor performance of woodwork students in examinations over the years in Niger State. The results in the past three years shows that in the year 2012 only 33.60% made a good pass, also in the year 2013 only 29.03 made a good grade while in 2014 only 25.40% made a good grade. This continuous poor academic achievement no doubt, reduces students'interest, leads to poor knowledge retention in woodwork technology and has other adverse effects on the entire programme objectives of this course. It has been observed that most of the Woodwork technology craftsmen from technical colleges even after employment often abandoned their occupation or have their attention divided over another vocation and even engage in jobs like hawking of petroleum products, illegal foreign exchange market business and political thuggery which are not in line with the training they received. Hence, it was necessary to adopt instructional approaches that would be more effective in improving students'academic and psychomotor achievement in woodwork technology. This study is therefore, designed to determine the effects of Challenge – Based and Activity – Based learning approaches on technical college students' achievement and retention in Woodwork technology in Niger State.

1.3 Purpose of the Study

The purpose of this study is to determine the effects of Challenge – Based and Activity – Based learning approaches on technical college students'achievement, interest and retention of learning in Woodwork technology in technical colleges. Specifically, the study is designed to determine the,

1. Effect of Challenge – Based and activity–based learning approaches on students' cognitive achievement in Woodwork technology.
2. Effect of Challenge – Based and activity–based learning approaches on students' retention of learning in Woodwork technology.
3. Effect of Challenge – Based and activity–based learning approaches on students' psychomotor achievement in Woodwork technology.

1.4 Research Questions

The following three research questions were formulated to guide this study:

1. What is the effect of Challenge – Based and Activity – Based learning approaches on students 'cognitive achievement in Woodwork technology?
2. What is the effect of Challenge – Based and Activity – Based learning approaches on students' retention of learning in Woodwork technology?

3. What is the effect of Challenge – Based and Activity – Based learning approach on students 'psychomotor achievement in Woodwork technology?

1.5 Hypotheses

The following null hypotheses guided the study and were tested at 0.05 level of significance:

HO_1: There is no significant difference between the mean effect of Challenge – Based and Activity – Based learning approach on students' academic achievement in Woodwork technology.

HO_2: There is no significant difference between the mean effect of gender on Woodwork technology cognitive achievement of students (male and female) when taught using Challenge – Based and Activity – Based learning approach.

HO_3: There is no significant interaction effect of treatment given to students taught using Challenge – Based and Activity – Based learning approach and their gender (male and female) with respect to their mean scores in Woodwork technology cognitive achievement test.

2. RESEARCH METHODOLOGY

This study adopts a quasi-experimental design. Specifically, the pretest, posttest design was employed for the study.

The study was conducted in Niger state because the state is one of the states where students 'poor performance in woodwork was reported by National Board for Technical Education (NBTE) 2011- 2014

The population for this study consists of all 122 second year students of Woodwork technology in the four technical colleges offering woodwork technology in Niger State. The data was obtained from the students who registered in each school. Simple random sampling was used to select the sample the sample. NTC II was used because they have studied Woodwork technology in their first year and should have had basic understanding of Woodwork technology terms, materials and tools of the trade. The distribution of the population was accomplished according to schools.

Simple random sampling technique (balloting) was used to assign two schools to challenge based learning approach group and two schools to Activity – Based learning approach group. Two intact classes of year II students each to the two treatment groups. Each intact class comprises of male and female students the entire population of 122 was used for the study.

The instruments used for data collection for this study consists of woodwork technology cognitive achievement test (WTCAT)

Both content and face validation were carried on WTCAT. A table of specification was built for the WTCAT in order to ensure their content validity. Based on the table of specification, a total of 82 multiple choice items were drawn for the WTCAT. Three experts from the department

of Industrial and Technology Education, Federal University of Technology Minna and two Woodwork technology teachers from technical colleges in Niger State.

The WTCAT was trial-tested on 40 NTCII students in Government Technical College, Patigi, Kwara State using test retest reliability technique. The reliability of the WTCAT was determined using Pearson Product Moment Correlation Coefficient and was found to be .78

A three -day intensive briefing was organized for the teachers that were used as research assistants.

Pre-test was first administered to the two groups using WTCAT, before the treatment exercise to determine the equivalence of the subjects assigned to challenge based learning group and Activity – Based learning group. Then treatment commenced in all the groups. Challenge based learning group was taught woodwork technology with CBL lesson plans while the Activity – Based learning group was taught woodwork technology using the ABL teaching plans. This lasted for 8weeks.

The data collected from the pre-test, post-test, were analyzed using mean to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance.

3. RESULTS

Research Question 1:

What is the effect of Challenge – Based and Activity – Based learning approaches on students 'cognitive achievement in Woodwork technology?

Table 1: Mean and Standard Deviation of Pre-test and Post-test Scores of challenged-based learning group and activity-based learning group in the Cognitive Achievement Test

Group	N	Pretest scores	SD	Post test score	SD	Mean Gain
CBL	63	31.66	9.63	66.69	9.84	35.03
ABL	59	28.98	10.08	62.54	10.19	33.56

The data presented in Table l shows that CBL approach group had a Mean score of 31.66 and Standard Deviation of 9.63 in the pre-test and a Mean score of 66.69 and Standard Deviation of 9.84 in the post-test making a pre-test, post-test Mean gain of 35.03. Activity-based learning approach had a Mean score of 28.98 and Standard Deviation of 10.08 in the pre-test and a post-test Mean of 62.54 and Standard Deviation of 10.19, with a pre-test, post-test mean gain of 33.56. With these results, both challenge based learning and activity-based learning are effective in improving students' cognitive achievement in woodwork technology, but the effect of CBL Approach in improving students' cognitive achievement in wood work technology is higher than the effect of ABL Approach.

Research Question 2

What is the effect of challenge-based and activity – based learning approach on students'retention of learning in Woodwork technology?

Table 2: Mean and standard deviation of post-test and retention scores of CBL approach group and ABL approach group in cognitive retention of learning test.

Group	N	Post-test	SD	Retention score	SD	Mean loss
CBL	63	66.69	9.84	54.08	8.43	12.61
ABL	59	62.54	10.19	49.00	9.98	13.54

Table 2 shows that CBL approach group had a mean score of 66.69 and standard deviation of 9.84 in the post-test and a mean score of 54.08 and standard deviation of 8.43 in the retention of learning making a post-test, retention test mean loss of 12.61. ABL approach group had a mean score of 62.54 and standard deviation of 10.19 in the post-test and a retention test mean of 49.00 and standard deviation of 9.98, with a post-test, retention test mean loss of 13.54 with these result, CBL approach group retention of learning is higher than the retention of learning of the group in ABL. The results therefore, indicates that the group taught wood work technology with CBL approach retained their learning better than those taught with ABL approach.

Research Question 3

What is the effect of challenge-based and Activity – based learning approach on students'psychomotor achievement in Woodwork technology?

Table 3: Mean and standard deviation of pre-test and post-test scores of CBL approach group and ABL approach group in psychomotor achievement test for achievement test

Group	N	Pretest scores	SD	Posttest scores	Mean gain
CBL	63	17.66	10.08	65.87	48.21
ABL	59	21.35	9.81	66.01	44.66

Table 3 shows that CBL Learning approach group had a Mean score of 17.66 and Standard Deviation of 10.08 in the pre-test and a Mean score of 65.87 and Standard deviation of 13.51 in the post-test making a pre-test, post-test Mean gain of 48.21. ABL approach had a Mean score of 21.35 and Standard Deviation of 9.81 in the pre-test and a post-test Mean of 66.01 and Standard Deviation of 13.31 with a pre-test, post-test Mean gain of 44.66. With these results, both CBL approach and ABL approach are effective in improving students psychomotor achievement in woodwork Technology but the effect of CBL approach in

improving students'psychomotor achievement in woodwork Technology is higher than the effect of ABL approach.

Hypotheses

HO_1: There is no significant difference between the mean effect of challenge-based and activity – based learning approach on students' academic achievement in Woodwork technology.

HO_2: There is no significant difference between the mean effect of gender on Woodwork technology cognitive achievement of students (male and female) when taught using challenge-based and activity – based learning approach.

HO_3: There is no significant mean interaction effect of treatment given to students taught using challenge-based and activity – based learning approach and their gender (male and female) with respect to their mean scores in Woodwork technology cognitive achievement test.

Table 4: Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Effect of Treatments (CBL and ABL), their Gender and Interaction Effect with Respect to their Mean Scores on Woodwork Technology Cognitive Achievement Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6019.303[a]	14	429.950	9.284	.000
Intercept	116029.049	1	116029.049	2505.394	.000
METHOD	3963.837	8	495.480	10.699	.000
GENDER	7.731	1	7.731	.167	.684
GENDER * METHOD	82.602	5	16.520	.357	.877
Error	4955.352	107	46.312		
Total	336096.000	122			
Corrected Total	10974.656	121			

a. R Squared = .548 (Adjusted R Squared = .489)
*Significant at sig of F< .05

The data presented in Table 4 shows F-calculated values for three effects: treatment, gender and interaction effect of treatments and gender on students cognitive achievement in woodwork Technology. The F-calculated value for treatment is 10.699 with a significance of F at .000 which is less than 0.05. Hence, the null-hypothesis of no significant mean difference between the effect of CBL approach and ABL approach on students'cognitive achievement in woodwork technology is therefore rejected at .05 level of significance. The result implies that the mean difference between the effect of CBL approach and ABL approach was significant. The F-calculated value for gender as shown in Table 9 is .167 with a significance of F at .684 which is greater than .05. Therefore, the null hypothesis of no significant difference between the mean effect of gender (male and female) on students'cognitive achievement in woodwork Technology

is accepted at .05 level of significance. This means that there was no significant mean difference between the effects of gender on students‘ cognitive achievement in woodwork Technology. The interaction of treatments and gender has F-calculated value of .357 with a significance of F at .877 which is greater than .05. Therefore, the null hypothesis of no significant interaction effect of treatments and gender is accepted. This means that there was no significant interaction effect of treatments given to students taught with CBL approach and ABL learning approach and their gender with respect to their mean scores on woodwork Technology cognitive achievement test.

4. DISCUSSION OF FINDINGS

The purpose of this study was to determine the effects of challenge-based and activity-based learning approaches on technical college students‘achievement and retention in woodwork technology as well as their effect on gender. The findings that have emerged from the study are hereby discussed.

The data presented in Table l provided answer to research question one. It was revealed that CBL approach and CBL are effective in improving students‘cognitive achievement in woodwork Technology, but the effect of CBL approach in improving students‘cognitive achievement in woodwork Technology is higher than ABL approach. Analysis of covariance was used to test the first hypothesis (Table 4) at the calculated F-value (10.699), Significance of F (.000) and confidence level of .05. The result shows that the mean difference between the effect of Activity-based learning approach and Challenge-based learning approach in woodwork Technology cognitive achievement was statistically significant. This means that CBL is more effective than ABL approach in improving students‘ cognitive achievement in woodwork Technology.

The above findings are consistent with the findings of Kabiru (2010), Ade (2013), John and Adams (2011) and Umar (2012) Who, in their separate studies in other subjects found that the CBL instructions' had significant effect upon the students‘cognitive achievement than other instructional formats. The findings of this study also support some literature evidence such as Araz (2007) who stated that when learners are exposed to new ideas that are presented through different intelligences, they will have a better chance to learn, remember the information and apply their learning experiences to other situations which can lead to higher achievement. Therefore, the result of this study with regard to students‘cognitive achievement is attributed to the treatment given to students in CBL group.

The findings could be explained by the fact that teacher‘s adoption of various instructional techniques (such as active learning, collaborative learning, and self-assessment) in CBL & ABL classroom appealed to the students‘ different intelligences and engaged the students in the learning process which increased their motivation to learn and strengthened their memory. The results could as well be explained thus: giving students opportunity to participate actively in the class through free interaction with the teacher and their peers and allowing them to learn in groups and assess their performance themselves engaged the students in the learning process; and consequently improved their ability to explore issues and articulate their own ideas. This, in turn, improved their learning and thinking abilities which led to deeper understanding of difficult technology concepts and principles associated with woodwork Technology. It implies that students in CBL approach remembered and applied more of their learning in woodwork Technology than the other group of students that were taught through ABL approach.

The data presented in table 2 provided answer to research question 2. Finding reveal that student taught with CBL approach had a higher means score than those taught with the ABL in the test for retention of learning. The analysis of covariance of the retention test presented in Table 10 confirmed that the difference in the mean score of the students taught with the CBL approach and those taught with ABL is significant. This showed that the CBL approach have positive effect on the students retention of learning in woodwork technology. These findings stemmed from the fact that CBL enhances hands-on activities which places learning in the hands of the students. The provision of active learning environment where students can be engaged and participate actively in class discussion increase the students‘ ability to explore issues and articulate their own ideas. Also the use of open ended questions by the teacher makes the students to engage in higher order thinking task such as analysis, synthesis and evaluation. These consequently improve students‘ cognitive achievement and also retention. This affirms Shri-Krishna & Badri (2013) views that active learning approach facilitate active knowledge construction, develops higher order thinking skills, improves memory and enhance transfer of learning to other situation. Bayraktav (2007) was of the opinion that by teaching students to think, they will gradually begin to realize that conscious reflection secretes understanding. He maintained that when students learn to think, they will be able to tackle all sort of new problem creatively and will have acquired some confidence.

In any educational practices, when students work or learn in groups collaboratively using real object, each person, in order to be an effective participant, will need to think critically in order to make logical contributions. Moreover, when students learn in groups, the bright ones always help the dull ones to understand the subject matter being learnt. This affirms Omeje (2013) and Inmam (2011) view that collaborative learning enhances critical thinking skills and hence, cognitive achievement and retention of learning.

The data presented in Table 3 provided answer to research question three. It was revealed that learning model and intelligences learning model are effective in improving students‘psychomotor achievement in woodwork Technology, but the effect of CBL and ABL in improving students‘psychomotor achievement in woodwork technology is higher than ABL. The result indicates that CBL is more effective in improving students‘psychomotor achievement in woodwork Technology. However, analysis of covariance was used to test the seventh hypothesis (Table 11) at the calculated F- value (23.077), significance of F (.000) and confidence level of .05. It was revealed that the mean difference between the effect of CBL and ABL on students‘psychomotor achievement in woodwork Technology was not statistically significant. Hence, the null hypothesis of no significant mean difference was not accepted. The result means that there was significant mean difference between the effect of CBL and ABL on students‘psychomotor achievement in woodwork technology.

4.1 Implications of the Findings

The findings of this study have implications for government and administrators of Technical Colleges, Technical teachers and National Board for Technical Education (NBTE).
This study found out that challenge-based learning approach had positive effects on cognitive achievement, psychomotor achievement and retention of learning in woodwork technology. This finding implies that teachers have to adopt this approach by incorporating it into the teaching and learning woodwork technology. The implication to the curriculum planners of technical

programmes (such as NBTE) is that, they will develop appropriate woodwork technology curriculum that will make provision for the teachers to adopt various techniques of challenge-based learning approach used in the study.

The adoption of the challenge-based learning instructional approach will make the use of tools and machines very easy for the students to learn and work collaboratively. This implies that school administrators and the government need to constantly make provision for up-to-date facilities such as workshops, tools, machines and consumables that will provide the teachers and students the opportunity to adopt this approach.

5. CONCLUSIONS

This study determined the effects of challenge-based and activity-based learning approaches on technical college students'achievement, interest and retention in woodwork technology. The challenge-based learning approach used in this study greatly affected the students learning of woodwork technology. This was reflected in the students'cognitive, psychomotor achievements and retention of learning. In other words, students learnt woodwork technology and psychomotor skills better because they were allowed to participate actively in the classroom teaching and learning by interacting with teacher, learning environment and their colleagues work and learn together in groups. Also students retained their learning for a longer time when they were allowed to think on possible solutions to a problem while engaging in practical activities with real objects, tools and machines collaboratively. It is hoped therefore, that if the challenge-based learning approach is taken into consideration in the teaching of woodwork technology in the Technical Colleges, craftsmen trained will graduate from the Technical Colleges with knowledge, psychomotor skills, strong problem solving skills, creative thinking, collaborative work and independent decision making skills will make them adaptable to the present and envisaged changes in the woodwork technology industries occasioned by technological advancement. Consequently, the craftsmen will be able to Improve on their learning and pass NABTEB examinations with better grades, contribute their quota to industrial development of this nation, and become employers of labor instead of hoping solely on paid employment.

5.1 Recommendations

Based on the findings of this study, the following recommendations are made;

- Technical College teachers should adopt the use of challenge-based learning approach to the teaching of woodwork technology.
- National Board for Technical Education (NBTE) should consider review of curriculum for woodwork technology programme with a view to incorporating the challenge-based learning approach into the teaching of woodwork technology.
- Government should provide tools and equipment needed to teach the state-of-the-art of woodwork technology in the Technical Colleges.
- Ministry of education and administrators of Technical Colleges should always organize seminar, conferences and workshops to sensitize technical teachers on the use of the challenge-based learning approach.

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